PAT-NO: JP411108890A

DOCUMENT-IDENTIFIER: JP 411108890 A

TITLE: ELECTROPHORESIS DETECTING APPARATUS

PUBN-DATE: April 23, 1999

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APPL-NO: JP09271052

APPL-DATE: October 3, 1997

INT-CL (IPC): G01N027/447

ABSTRACT:

PROBLEM TO BE SOLVED: To provide an electrophoresis detecting apparatus by
which a very small sample can be analyzed without making a separation length large, by which the sample can be analyzed at high speed and by which the sample can be measured with high accuracy by providing a plurality of potential-gradient-detecting electrodes which are installed mutually in parallel with a board and which are exposed partly in a solution flow passage.

SOLUTION: A first potential-gradient-detecting electrode 33 and a second potential-gradient detecting electrode 34 are installed mutually in parallel with a board, and they are exposed partly in a solution flow passage 32. In this case, the electrodes are installed at an interval of 2 μm, and their

electrode width is set at 2 μm. After the inside of the solution flow passage 32 is filled with a preceding electrolytic solution, a sample solution tank 35 is attached to the board, a sample in a definite amount is injected by a head-pressure injection operation or the like, and the sample solution tank 35 is replaced by an end electrolytic-solution tank 4. After that, a high voltage is applied from a high-voltage power supply 8 across both ends of a preceding electrolytic-solution, tank 1 and the end electrolytic-solution tank 4. Respective components in the sample are separated inside the solution flow passage 32 due to the difference in their mobility, and the respective components, the preceding electrolytic solution and an end electrolytic solution are moved inside the solution flow passage 32 at an equal speed. As a result, since the interval between the very small electrodes 33, 34 is 2 μm, it is possible to detect a component length at an interval of 2 μm or higher.

JP 411108890 A
Machine Translation

Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to high-speed highly precise electrophoresis detection equipment.
[0002]
[Description of the Prior Art] the configuration explanatory view of the conventional example in which drawing 8 and drawing 9 are generally used conventionally -- it is -- for example, title; isotachophoresis and drawing 2 [of P4] . -- 1, drawing 3 .1 of P23, date-of-issue; February 1, 1980, author; Miyazaki **** Kazuo Kato, and publishing office; Kodansha It is shown.
[0003] In drawing 8 , the detector to which, as for 1, the leading electrolyte tub was connected to the leading electrolyte tub 1, and, as for 2, the end was connected, and 3 are the capillaries by which the end was connected to the other end of a detector 2. 4 is the terminating electrolyte connected to the other end of a capillary 3. 5 is the micro syringe prepared in the connection part of a capillary 3 and a terminating electrolyte 4.
[0004] The electrode with which 6 was prepared in the leading electrolyte tub 1, and 7 are the electrodes prepared in the terminating electrolyte 4. 8 is the high-voltage power source established between the electrode 6 and the electrode 7. 9 is the separation passage part prepared in the capillary 3.
[0005] Drawing 9 is the detail drawing of a detector 2, and drawing 10 is the important section detail drawing of drawing 9 . For 11, as for cel body covering and 13, in drawing 9 , the cel body and 12 are [Spacer A and 14] Spacers B.
[0006] For the fitting socket B and 17, as for a platinum electrode and 19, a capillary tube and 18 are [15 / the fitting socket A and 16 / an insulating material and 21] leads.
[0007] In the above configuration, after filling the inside of a capillary 3 with a leading electrolyte A, the sample B of a constant rate is poured in by the micro syringe 5. Then, the high voltage is impressed to the both ends of the leading electrolyte tub 1 and the terminating electrolyte tub 4 according to the high-voltage power source 8.
[0008] As shown in drawing 11 , each component is separated in the capillary 3 interior by the difference in the mobility of each component in Sample B. And all each components, the leading electrolytes A, and terminating electrolytes C come to move at uniform velocity in the inside of a capillary 3.
[0009] In this case, since the die length within the capillary 3 of the separated sample B component is proportional to the concentration included in Sample B, quantitative analysis becomes possible. Of course, qualitative analysis is also possible with the difference in mobility (detection time).
[0010]
[Problem(s) to be Solved by the Invention] However, the electric potential gradient detector used for high sensitivity detection of isotachophoresis equipment measures the potential difference of a certain distance in a capillary 3, as shown in drawing 10 . Since this distance has constant value, detection of a slight amount carries out in ****, and it is, and is **.

[0011] That is, since it was the 50-micrometer insulating material 19 of Teflon, specifically, determining distance in the case of the electric potential gradient detector for detecting the sample of the drawing 9 conventional example had the trouble of being undetectable, about what is divided into 50 micrometers or less of segregation length (thing of very small concentration).
[0012] For this reason, conventionally, when sample detection of a slight amount was performed, it is pouring in a sample in large quantities, and die length after separation of a sample was lengthened. Therefore, since capillary 3 merit also needed this for a long time, measurement time amount was long.
[0013] Moreover, since the sample length measuring accuracy after separation was also based on the precision of the insulating material 19 which has determined spacing of an electrode 18, also when high measurement of precision was performed, the sample needed to be paid in large quantities. Consequently, in order to raise a slight quantity of sample detection and sample length measuring accuracy, high-speed measurement cannot be performed.
[0014] This invention solves this trouble. The purpose of this invention is to offer high-speed highly precise electrophoresis detection equipment.
[0015]
[Means for Solving the Problem] It is electrophoresis detection equipment characterized by providing the 1st and 2nd electric potential gradient detection form electrode which this invention is mutually parallel to said substrate with the liquid flow channel prepared in a substrate and this substrate in the electrophoresis detection equipment of the electric potential gradient detection form of (1) electrophoresis apparatus, and it is prepared in order to attain this purpose, and a part exposes to this liquid flow channel, respectively.
(2) Electrophoresis detection equipment given in (1) characterized by providing the liquid flow channel formed of the semi-conductor process, and the 1st and 2nd electric potential gradient detection form electrode.
(3) (1) characterized by providing the substrate which consists of glass material, or electrophoresis detection equipment given in (2).
(4) (1) characterized by providing the substrate which consists of macromolecule resin material, or electrophoresis detection equipment given in (2).
(5) (1) characterized by providing the separation passage where it was prepared in said substrate and the end was connected to said liquid flow channel, (2), (3), or electrophoresis detection equipment given in (4).
(6) (1) to which most is characterized by providing the liquid flow channel which consisted of capillary tubes, (2), (3), or electrophoresis detection equipment given in (4).
It constitutes. Hereafter, it explains to a detail based on an example.
[0016]
[Embodiment of the Invention] For drawing 1 , the important section configuration explanatory view of one example of this invention and drawing 2 are [the important section detail drawing of drawing 1 and drawing 4 of the side elevation of drawing 1 and drawing 3] the side elevations of drawing 3 . In drawing, the configuration of the same notation as drawing 8 expresses the same function. Hereafter, only drawing 8 and a difference part are explained.
[0017] 31 is a substrate. A substrate 31 consists one field of the substrate body 311 and the substrate body 311 of wrap substrate covering 312, as shown in drawing 4 . In

addition, in drawing 1 , in order to make it intelligible, the substrate covering 312 shows the condition of having removed.
[0018] A substrate 31 consists of glass material in this case. In addition, configuration ****** is also better than macromolecule resin material. 32 is the liquid flow channel prepared in this substrate body 311. In this case, a depth of 5 micrometers and width of face of 100 micrometers are made.
[0019] 33 and 34 are 1st and 2nd electric potential gradient detection form electrode which it is mutually parallel to a substrate 31, and is prepared, and a part exposes to a liquid flow channel 32, respectively. In this case, it is 2 micrometers in spacing mutually, and electrode width of face makes 2 micrometers.
[0020] 35 carries out exchange D to the terminating electrolyte tub 4 at the time of sample impregnation, and is an attachment **** sample solution tub at a substrate 31. 36 is the separation passage established in the liquid flow channel 32.
[0021] In the above configuration, after filling the inside of a liquid flow channel 32 with a leading electrolyte A, the sample solution tub 35 is attached in a substrate 31, and the sample B of a constant rate is poured in by the head douche close or electric impregnation. Exchange D of the sample solution tub 35 and the terminating electrolyte tub 4 is carried out. Then, the high voltage is impressed to the both ends of the leading electrolyte tub 1 and the terminating electrolyte tub 4 according to the high-voltage power source 8.
[0022] As shown in drawing 11 , each component is separated in the liquid flow channel 32 interior by the difference in the mobility of each component in Sample B. And all each components, the leading electrolytes A, and terminating electrolytes C move at uniform velocity in the inside of a liquid flow channel 32.
[0023] consequently, the minute electrode 33 -- since the electric potential gradient detector configuration of the 2-micrometer spacing ** was specifically carried out, it specifically becomes detectable [the component length more than 2 micrometer spacing] more than minute spacing length 34 spacing. That is, since a minute electric potential gradient detector can be manufactured using (1) semi-conductor process, even if it does not lengthen separation length, analysis of a minute sample is attained, and the electrophoresis detection equipment which can realize high-speed analysis is obtained.
(2) Since an electrode spacing can be minutely manufactured using a semi-conductor process, the electrophoresis detection equipment which is highly precise and can realize the measurements of length of the separation sample B is obtained.
(3) Since a substrate 31 is made and loaded according to a semi-conductor process at a precision, it becomes unnecessary [assembly precision with an advanced detector part], and since it is a substrate-like, exchange of a substrate 31 is also easy and cheap electrophoresis detection equipment is obtained.
(4) If separation passage is included in a substrate 31, it is not necessary to prepare separation passage independently and, and an attachment ******** man day will not need separation passage, either, but cheap electrophoresis detection equipment will be obtained.
[0024] (5) If the separation passage 36 is included in a substrate 31, the electrophoresis detection equipment with an easy miniaturization as the whole equipment will be obtained.
[0025] (6) If glass material is used for a substrate 31, in a separation passage front face,

surface treatment which is used by the commercial GARAKYAPI rally tube will be easy, and the optimal electrophoresis detection equipment for the sample solution B for detection will be obtained.
[0026] (7) If macromolecule resin material is used for a substrate 31, the electrophoresis detection equipment with which the chemical modification suitable for separation can perform a separation passage front face easily will be obtained.
[0027] Drawing 5 is the manufacture process explanatory view of the substrate 31 of the drawing 3 example, and uses a semi-conductor process. Here, (a) is a front view and (b) is a sectional side elevation.
[0028] Step 1 shows the 1st, the 2nd electric potential gradient detection form electrode 33, and the slot formation process for 34. The slot 42 for electrodes is formed in a glass substrate 41 by etching. In this case, it is made 1-micrometer ****.
[0029] Step 2 shows the slot formation process of a liquid flow channel 32. By etching, the passage slot 43 for a liquid flow channel 32 is formed in a glass substrate 41. In this case, it is made 5-micrometer ****.
[0030] Step 3 shows the formation process of the 1st and 2nd electric potential gradient detection form electrode 33 and 34. A platinum electrode 44 is formed in the slot 42 for electrodes by the spatter in this case, and a platinum electrode 44 is made into the thickness of 0.35 micrometers.
[0031] Step 4 indicates it like the clearance packer of the slot 42 for electrodes by resin as junction of the substrate covering 45. The substrate covering 45 is joined to a glass substrate 41. The clearance between cover glass 45 and a platinum electrode 44 is filled up with resin 46. In this case, the epoxy resin is used.
[0032] The important section configuration explanatory view of the example of everything [drawing 6] but this invention and drawing 7 are the side elevations of drawing 6 . In this example, although the chip of one constituted the liquid flow channel 32 and the body 51 of a detector from the drawing 1 example, a part of body 51 of an electric potential gradient detector and liquid flow channel 32 are manufactured in a semi-conductor process, and it uses the commercial capillary tube 52 instead of most liquid flow channels 32.
[0033] In addition, in drawing 6 , in order to make it intelligible, the substrate covering 312 shows the condition of having removed. Since what is necessary is just to manufacture a part of body 51 of an electric potential gradient detector, and liquid flow channel 32, cheap electrophoresis detection equipment is obtained. Moreover, since what is necessary is just to exchange a capillary tube 52 when resolving power gets worse, the electrophoresis detection equipment which can reduce a maintenance cost is obtained.
[0034] In addition, in the above-mentioned example, although it was attached to isotachophoresis equipment and explained, it does not restrict to this, for example, a zone electrophoresis and gel electrophoresis can also be applied. In short, what is necessary is just the analysis apparatus which impresses an electrical potential difference to the both ends of a capillary. Moreover, in the above-mentioned example, although it explained that a substrate 31 consisted of glass material, it may not restrict to this, for example, the composite of glass material and macromolecule resin material is sufficient.
[0035]
[Effect of the Invention] according to [as explained to the detail above] claim 1 of this invention -- (1) -- since a minute electric potential gradient detector can be manufactured,

even if it does not lengthen separation length, analysis of a minute sample is attained, and the electrophoresis detection equipment which can realize high-speed analysis is obtained.
(2) Since an electrode spacing can be manufactured minutely, the electrophoresis detection equipment which is highly precise and can realize the measurements of length of a separation sample is obtained.
[0036] according to claim 2 of this invention -- (1) -- since the semi-conductor process currently generally used widely can be used -- cheap -- minuteness and high energy -- dense electrophoresis detection equipment is obtained.
(2) Since a substrate is made and loaded according to a semi-conductor process at a precision, it becomes unnecessary [assembly precision with an advanced detector part], and since it is a substrate-like, exchange of a substrate is also easy and cheap electrophoresis detection equipment is obtained.
[0037] According to claim 5 of this invention, since separation passage was included in (1) substrate, it is not necessary to prepare separation passage independently and, and an attachment ******** man day does not need separation passage, either, but cheap electrophoresis detection equipment is obtained.
[0038] (2) Since separation passage was included in the substrate, the electrophoresis detection equipment with an easy miniaturization as the whole equipment is obtained.
[0039] (3) If glass material is used for a substrate, surface treatment which is used by the commercial GARAKYAPI rally tube will be easy, and the optimal electrophoresis detection equipment for the sample solution for detection will be obtained.
[0040] (4) If macromolecule resin material is used for a substrate, the electrophoresis detection equipment which the chemistry ornament suitable for separation can perform easily will be obtained.
[0041] According to claim 6 of this invention, since what is necessary is just to manufacture a part of body of (1) electric-potential-gradient detector, and liquid flow channel, cheap electrophoresis detection equipment is obtained.
(2) Since what is necessary is just to exchange capillary tubes when resolving power gets worse, the electrophoresis detection equipment which can reduce a maintenance cost is obtained.
[0042] Therefore, according to this invention, high-speed highly precise electrophoresis detection equipment is realizable.

[Claim(s)]
[Claim 1] Electrophoresis detection equipment characterized by providing a substrate, the liquid flow channel prepared in this substrate, and the 1st and 2nd electric potential gradient detection form electrode which it is mutually parallel to said substrate, and is prepared, and a part exposes to this liquid flow channel, respectively in the electrophoresis detection equipment of the electric potential gradient detection form of an electrophoresis apparatus.
[Claim 2] Electrophoresis detection equipment according to claim 1 characterized by providing the liquid flow channel formed of the semi-conductor process, and the 1st and 2nd electric potential gradient detection form electrode.
[Claim 3] Electrophoresis detection equipment according to claim 1 or 2 characterized by providing the substrate which consists of glass material.

[Claim 4] Electrophoresis detection equipment according to claim 1 or 2 characterized by providing the substrate which consists of macromolecule resin material.
[Claim 5] Electrophoresis detection equipment of claim 1 characterized by providing the separation passage where it was prepared in said substrate and the end was connected to said liquid flow channel, claim 2, claim 3, or claim 4 **.
[Claim 6] Claim 1 to which most is characterized by providing the liquid flow channel which consisted of capillary tubes, or electrophoresis detection equipment according to claim 2, 3, or 4.

Brief Description of the Drawings]
[Drawing 1] It is the important section configuration explanatory view of one example of this invention.
[Drawing 2] It is the side elevation of drawing 1 .
[Drawing 3] It is the important section detail drawing of drawing 1 .
[Drawing 4] It is the side elevation of drawing 3 .
[Drawing 5] It is the manufacture process explanatory view of drawing 1 .
[Drawing 6] It is the important section configuration explanatory view of other examples of this invention.
[Drawing 7] It is the side elevation of drawing 6 .
[Drawing 8] It is the configuration explanatory view of the conventional example currently generally used conventionally.
[Drawing 9] It is the important section detail explanatory view of drawing 8 .
[Drawing 10] It is the important section detail explanatory view of drawing 9 .
[Drawing 11] It is the explanatory view of drawing 8 of operation.
[Description of Notations]
1 Leading Electrolyte Tub
2 Detector
4 Terminating Electrolyte Tub
6 Electrode
7 Electrode
8 High-Voltage Power Source
31 Substrate
311 Substrate Body
312 Substrate Covering
32 Liquid Flow Channel
33 1st Electric Potential Gradient Detection Form Electrode
34 2nd Electric Potential Gradient Detection Form Electrode
35 Sample Solution Tub
36 Separation Passage
41 Glass Substrate
42 Slot 42 for Electrodes
43 Passage Slot
44 Platinum Electrode
45 Substrate Covering
46 Resin 46

51 Body of Detector
52 Capillary Tube
A Leading electrolyte
B Sample
C Terminating electrolyte
D Exchange